

CLAIMS

What is claimed is:

1 1. A thermally monitored power dissipating semiconductor device,
2 comprising:

3 a power dissipating device structure operative to generate a
4 temperature difference between a relatively cold peripheral area
5 of the device and a relatively warm central area of the device,
6 the temperature difference having a known relationship to
7 electrical operating conditions of the device; and

8 a Seebeck effect thermoelectric sensor integrally formed
9 with the device structure, the sensor having one or more warm
10 junctions at the central area of the device and one or more cold
11 junctions at the peripheral area of the device, the sensor being
12 operative to generate an electrical output signal having a known
13 relationship to the temperature difference between the peripheral
14 and central areas of the device so as to provide an indication of
15 the electrical operating conditions of the device.

1 2. A semiconductor device according to claim 1, wherein the power
2 dissipating device structure comprises a power MOSFET.

1 3. A semiconductor device according to claim 1, wherein the power
2 dissipating device structure comprises source and drain diffusions
3 of a power MOSFET, and wherein the hot and cold junctions of the
4 sensor are formed by respective traces of polysilicon and metal
5 disposed over the source and drain diffusions.

1 4. A semiconductor device according to claim 1 having multiple
2 warm junctions and a corresponding number of cold junctions to
3 form a number of warm-cold junction pairs, the junction pairs
4 being connected in series such that the thermal-to-electrical gain

5 of the Seebeck sensor is substantially proportional to the number
6 of such pairs.

1 5. A semiconductor device according to claim 1, wherein the sensor
2 has a geometric arrangement effective to cancel the effect of
3 background thermal gradients on the substrate.

1 6. A circuit, comprising:

2 a power dissipating device arranged between a source and a
3 load, the device being operative to generate a temperature
4 difference between a relatively cold peripheral area of the device
5 and a relatively warm central area of the device, the temperature
6 difference having a known relationship to electrical operating
7 conditions of the device;

8 a Seebeck effect thermoelectric sensor integrally formed
9 with the device, the sensor having one or more warm junctions at
10 the central area of the device and one or more cold junctions at
11 the peripheral area of the device, the sensor being operative to
12 generate an electrical output signal having a known relationship
13 to the temperature difference between the peripheral and central
14 areas of the device so as to provide an indication of the
15 electrical operating conditions of the device; and

16 circuitry operative in response to the electrical output
17 signal of the sensor to modify the operation of the circuit in a
18 corresponding predetermined fashion.

1 7. A circuit according to claim 6, wherein the temperature
2 difference from which the sensor generates the electrical output
3 signal is substantially independent of an average temperature
4 common to both the warm and cold junctions, and wherein the
5 electrical output signal is used by the operation-modifying
6 circuitry without any qualification as to absolute temperature.

1 8. A circuit according to claim 6, further comprising additional
2 temperature sensing circuitry operative to provide an indication
3 of an absolute temperature in a region near the power dissipating
4 device, and wherein the operation-modifying circuitry is operative
5 to qualify the electrical output signal from the sensor with the
6 indication from the additional temperature sensing circuitry.

1 9. A circuit according to claim 8, wherein the qualification of
2 the sensor output signal by the operation-modifying circuitry
3 includes the logical OR-ing of the sensor output signal with the
4 indication from the additional temperature sensing circuitry.

1 10. A circuit according to claim 8, wherein the qualification of
2 the sensor output signal by the operation-modifying circuitry
3 includes (1) comparing the sensor output signal with a variable
4 threshold value, and (2) decreasing the threshold value as the
5 temperature in the region near the device increases as indicated
6 by the additional temperature sensing circuitry.

1 11. A circuit according to claim 6, wherein the power dissipating
2 device is a power MOSFET.

1 12. A circuit according to claim 6, wherein the
2 operation-modifying circuitry is thermal protection circuitry
3 operative to effect a shutdown of the power-dissipating device
4 when the electrical output signal from the sensor indicates that
5 the power dissipation of the power-dissipating device is
6 approaching a predetermined acceptable maximum value.